

That Which Is Claimed Is:

1. An absorption solution comprising aqueous ammonia and at least one heteropoly complex anion of a transition metal element present in an amount sufficient to provide a corrosion inhibiting effect.

5 2. The solution of Claim 1, said solution further comprising at least one additional additive in an amount sufficient to provide a corrosion inhibiting effect.

3. The solution of Claim 1, wherein said at least one heteropoly complex anion comprises at least one transition metal atom having corrosion inhibiting properties in absorption refrigeration systems.

10 4. The solution of Claim 1, wherein said at least one heteropoly complex anion comprises a compound selected from the group consisting of $[X_aM_bO_c]^{-n}$, $[X_aZ_dM_bO_c]^{-n}$, $[X_aZ_dM_bO_cH_e]^{-n}$, $[X_aM_bO_c(OH)_f]^{-n}$, $[X_aZ_dM_bO_c(OH)_f]^{-n}$, and mixtures thereof, wherein:

15 X and Z are central heteroatoms selected from the group consisting of elements from Groups I-VIII of the Periodic Table of Elements;

a is 1 or 2;

d is an integer from 0 to 4;

20 M_bO_c , $M_bO_cH_e$, and $M_bO_c(OH)_f$ are oxoanions in which M is a transition metal element; b is an integer from 5 to 22; c is an integer from 20 to 70; e is an integer from 0 to 6; and f is an integer from 0 to 3; and

n is the charge of the anion.

5. The solution of Claim 4, wherein:

X is phosphorus, silicon, manganese, tellurium or arsenic; and

M is molybdenum or tungsten.

25 6. The solution of Claim 1, wherein said at least one heteropoly complex anion is selected from the group consisting of phosphomolybdates, silicon molybdates, manganese molybdates, silicon tungstates, tellurium molybdates, arsenic molybdates, and mixtures thereof.

7. The solution of Claim 1, wherein said at least one heteropoly complex anion comprises a phosphomolybdate of the formula $[\text{PMo}_{12}\text{O}_{40}]^{-3}$.

8. The solution of Claim 2, wherein said at least one additional additive comprises at least one transition metal compound.

5 9. The solution of Claim 8, wherein said at least one transition metal compound is selected from compounds of transition metals which are capable of providing the transition metal element as ions in aqueous ammonia.

10 10. The solution of Claim 8, wherein said at least one transition metal compound comprises a transition metal which is different from the transition metal of the heteropoly anion complex.

11. The solution of Claim 8, wherein said at least one transition metal compound comprises a salt of a transition metal element.

15 12. The solution of Claim 11, wherein said salt comprises a compound selected from the group consisting of nitrates, halides, and oxides of transition metal elements, and mixtures thereof.

13. The solution of Claim 11, wherein said transition metal is selected from the group consisting of cobalt, nickel, tungsten, zirconium, manganese, chromium, and mixtures thereof.

20 14. The solution of Claim 11, wherein said salt is a halide of a transition metal element.

15. The solution of Claim 2, wherein said at least one additional additive comprises at least one compound of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements.

25 16. The solution of Claim 15, wherein said at least one compound of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements comprises a

compound capable of providing the metallic elements of Group IIIa to VIa as ions in alkali metal halide solutions.

17. The solution of Claim 15, wherein said at least one compound of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements comprises at least one salt of a metallic element of Group IIIa to VIa.

18. The solution of Claim 17, wherein said salt comprises a compound selected from the group consisting of oxides, sulfides, halides, nitrates, and mixtures thereof of metallic elements of Group IIIa to VIa.

19. The solution of Claim 17, wherein said salt comprises a halide of a metallic element of Groups IIIa to VIa.

20. The solution of Claim 17, wherein said at least one compound of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements comprises antimony as the metallic element of Groups IIIa to VIa.

21. The solution of Claim 17, wherein said at least one compound of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements comprises a compound selected from the group consisting of antimony bromide, germanium bromide, arsenic bromide, and bismuth bromide, and mixtures thereof.

22. The solution of Claim 1, wherein ammonia is present in an amount from about 1 to about 50 weight percent, based on the total weight of the solution.

23. An absorption solution for refrigeration systems, comprising aqueous ammonia, at least one heteropoly complex anion of a transition metal element, and at least one additional additive comprising a compound selected from the group consisting of transition metal salts, salts of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements, and mixtures thereof, said at least one heteropoly complex anion of a transition metal element and said at least one additional additive present in an amount sufficient to provide a corrosion inhibiting effect.

24. The solution of Claim 23, wherein said at least one heteropoly complex anion of a transition metal element comprises a phosphomolybdate, and said least one additional additive comprises at least one transition metal salt.

25. The solution of Claim 24, wherein said at least one transition metal salt comprises at least one halide of cobalt, nickel, tungsten, zirconium, manganese, chromium, and mixtures thereof.

26. The solution of Claim 23, wherein said at least one heteropoly complex anion of a transition metal element comprises a phosphomolybdate and said at least one additional additive comprises at least one salt of a metallic element of Group IIIa to VIa.

27. The solution of Claim 26, wherein said at least one salt comprises a halide of the metallic elements of Group Va of the Periodic Table of Elements.

28. The solution of Claim 27, wherein said halide comprises a compound selected from the group consisting of antimony bromide (SbBr_3), arsenic bromide, bismuth bromide and mixtures thereof.

29. The solution of Claim 23, wherein said at least one heteropoly complex anion of a transition metal element is $[\text{PMo}_{12}\text{O}_{40}]^{-3}$.

30. The solution of Claim 23, wherein ammonia is present in an amount from about 1 to about 50 weight percent, based on the total weight of the solution.

31. An absorption solution for refrigeration systems, comprising at aqueous ammonia, at least one phosphomolybdate, and at least one transition metal halide, said phosphomolybdate and said transition metal halide present in an amount sufficient to provide a corrosion inhibiting effect.

32. The solution of Claim 31, wherein said phosphomolybdate is $[\text{PMo}_{12}\text{O}_{40}]^{-3}$, and said transition metal halide is cobalt halide or nickel halide.

33. The solution of Claim 31, wherein ammonia is present in an amount from about 1 to about 50 weight percent, based on the total weight of the solution.

34. An absorption solution for refrigeration systems, comprising aqueous ammonia, at least one phosphomolybdate, and at least one halide of the metallic elements of Group Va of the Periodic Table of Elements, said phosphomolybdate and said halide present in an amount sufficient to provide a corrosion inhibiting effect.

5 35. The solution of Claim 34, wherein said phosphomolybdate is $[\text{PMo}_{12}\text{O}_{40}]^{-3}$, and said halide is antimony bromide (SbBr_3).

36. The solution of Claim 34, wherein ammonia is present in an amount from about 1 to about 50 weight percent, based on the total weight of the solution.

10 37. A process for inhibiting the corrosion of a machine resulting from the presence of absorbent solutions comprising aqueous ammonia, the process comprising circulating in a machine said absorption solution comprising aqueous ammonia and at least one heteropoly complex anion of a transition metal element, said at least one heteropoly complex anion of a transition metal element present in an amount sufficient to provide a corrosion inhibiting effect.

15 38. The process of Claim 37, wherein said solution further comprises at least one additional additive comprising a compound selected from the group consisting of transition metal compounds, compounds of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements, and mixtures thereof, said at least one additional additive present in an amount sufficient to provide a corrosion inhibiting effect.

20 39. The process of Claim 37, wherein during said circulating step, said at least one heteropoly complex anion forms a protective layer on a surface within said machine.

40. The process of Claim 37, wherein during said circulating step said solution is exposed to temperatures ranging from about 150°F to about 550°F.

25 41. The process of Claim 37, wherein said absorbent solution further comprises lithium nitrate and zinc halide.

42. The process of Claim 37, wherein ammonia is present in an amount from about 1 to about 50 weight percent, based on the total weight of the solution.

43. An absorption solution comprising at least one alkali metal hydroxide, alkaline earth metal hydroxide, or a mixture thereof and at least one heteropoly complex anion of a transition metal element present in an amount sufficient to provide a corrosion inhibiting effect.

44. The solution of Claim 43, further comprising at least one additional additive in an amount sufficient to provide a corrosion inhibiting effect.

45. The solution of Claim 43, wherein said at least one heteropoly complex anion comprises at least one transition metal atom having corrosion inhibiting properties in absorption refrigeration systems.

46. The solution of Claim 43, wherein said at least one heteropoly complex anion comprises a compound selected from the group consisting of $[X_aM_bO_c]^{-n}$, $[X_aZ_dM_bO_c]^{-n}$, $[X_aZ_dM_bO_cH_e]^{-n}$, $[X_aM_bO_c(OH)_f]^{-n}$, $[X_aZ_dM_bO_c(OH)_f]^{-n}$, and mixtures thereof, wherein:

X and Z are central heteroatoms selected from the group consisting of elements from Groups I-VIII of the Periodic Table of Elements;

a is 1 or 2;

d is an integer from 0 to 4;

M_bO_c , $M_bO_cH_e$, and $M_bO_c(OH)_f$ are oxoanions in which M is a transition metal element; b is an integer from 5 to 22; c is an integer from 20 to 70; e is an integer from 0 to 6; and f is an integer from 0 to 3; and

n is the charge of the anion..

47. The solution of Claim 46, wherein:

X is phosphorus, silicon, manganese, tellurium or arsenic; and
M is molybdenum or tungsten.

48. The solution of Claim 43, wherein said at least one heteropoly complex anion is selected from the group consisting of phosphomolybdates, silicon molybdates,

manganese molybdates, silicon tungstates, tellurium molybdates, arsenic molybdates, and mixtures thereof.

49. The solution of Claim 43, wherein said at least one heteropoly complex anion comprises a phosphomolybdate of the formula $[\text{PMo}_{12}\text{O}_{40}]^{-3}$.

5 50. The solution of Claim 49, wherein said at least one additional additive comprises at least one transition metal compound.

51. The solution of Claim 50, wherein said at least one transition metal compound is selected from compounds of transition metals which are capable of providing the transition metal element as ions in solution of alkali metal hydroxide, alkaline earth metal hydroxide, and mixtures thereof.

52. The solution of Claim 51, wherein said at least one transition metal compound comprises a transition metal which is different from the transition metal of the heteropoly anion complex.

53. The solution of Claim 50, wherein said at least one transition metal compound comprises a salt of transition metal element.

54. The solution of Claim 53, wherein said salt comprises a compound selected from the group consisting of nitrates, halides, and oxides of transition metal elements, and mixtures thereof.

55. The solution of Claim 53, wherein said transition metal is selected from the group consisting of cobalt, nickel, tungsten, zirconium, manganese, chromium, and mixtures thereof.

56. The solution of Claim 53, wherein said salt comprises a halide of a transition metal element.

57. The solution of Claim 44, wherein said at least one additional additive comprises at least one compound of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements.

58. The solution of Claim 57, wherein said at least one compound of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements comprises a compound capable of providing the metallic elements of Group IIIa to VIa as ions in alkali metal halide solutions.

5 59. The solution of Claim 58, wherein said at least one compound of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements comprises at least one salt of a metallic element of Group IIIa to VIa.

60. The solution of Claim 59, wherein said salt comprises a compound selected from the group consisting of oxides, sulfides, halides, nitrates, and mixtures thereof of metallic elements of Group IIIa to VIa.

61. The solution of Claim 59, wherein said at least one compound of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements comprises a halide of a metallic element of Groups IIIa to VIa.

62. The solution of Claim 59, wherein said at least one compound of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements comprises antimony as the metallic element of Groups IIIa to VIa.

63. The solution of Claim 59, wherein said at least one compound of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements comprises a compound selected from the group consisting of antimony bromide, germanium bromide, arsenic bromide, and bismuth bromide, and mixtures thereof.

64. The solution of Claim 43, wherein said alkali metal hydroxide, alkaline earth metal hydroxide or mixture thereof is present in an amount from about 20 to about 80 weight percent, based on the total weight of the solution.

65. An absorption solution for refrigeration systems, comprising at least one alkali metal hydroxide, alkaline earth metal hydroxide, or a mixture thereof, at least one heteropoly complex anion of a transition metal element, and at least one additional additive comprising a compound selected from the group consisting of transition metal

salts, salts of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements, and mixtures thereof, said at least one heteropoly complex anion of a transition metal element and said at least one additional additive present in an amount sufficient to provide a corrosion inhibiting effect.

5 66. The solution of Claim 65, wherein said at least one heteropoly complex anion of a transition metal element comprises a phosphomolybdate, and said least one additional additive comprises at least one transition metal salt.

 67. The solution of Claim 66, wherein said at least one transition metal salt comprises at least one halide of cobalt, nickel, tungsten, zirconium, manganese,
10 chromium, and mixtures thereof.

 68. The solution of Claim 65, wherein said at least one heteropoly complex anion of a transition metal element comprises a phosphomolybdate and said at least one additional additive comprises at least one salt of a metallic element of Group IIIa to VIa.

 69. The solution of Claim 68, wherein said at least one salt comprises an oxide
15 or halide of the metallic elements of Group Va of the Periodic Table of Elements.

 70. The solution of Claim 69, wherein said halide comprises antimony bromide (SbBr_3), arsenic bromide, or bismuth bromide.

 71. The solution of Claim 65, wherein said at least one heteropoly complex anion of a transition metal element is $[\text{PMo}_{12}\text{O}_{40}]^{-3}$.

20 72. The solution of Claim 65, wherein said alkali metal hydroxide, alkaline earth metal hydroxide or mixture thereof is present in an amount from about 20 to about 80 weight percent, based on the total weight of the solution.

 73. An absorption solution for refrigeration systems, comprising at least one alkali metal hydroxide, alkaline earth metal hydroxide, or a mixture thereof, at least one
25 phosphomolybdate, and at least one transition metal halide, said phosphomolybdate and said transition metal halide present in an amount sufficient to provide a corrosion inhibiting effect.

74. The solution of Claim 73, wherein said phosphomolybdate is $[\text{PMo}_{12}\text{O}_{40}]^{-3}$, and said transition metal halide is cobalt halide or nickel halide.

75. The solution of Claim 73, wherein said alkali metal hydroxide, alkaline earth metal hydroxide or mixture thereof is present in an amount from about 20 to about 80 weight percent, based on the total weight of the solution.

76. An absorption solution for refrigeration systems, comprising at least one alkali metal hydroxide, alkaline earth metal hydroxide, or a mixture thereof, at least one phosphomolybdate, and at least one halide of the metallic elements of Group Va of the Periodic Table of Elements, said phosphomolybdate and said halide present in an amount sufficient to provide a corrosion inhibiting effect.

77. The solution of Claim 76, wherein said phosphomolybdate is $[\text{PMo}_{12}\text{O}_{40}]^{-3}$, and said halide is antimony bromide (SbBr_3).

78. The solution of Claim 76, wherein said alkali metal hydroxide, alkaline earth metal hydroxide or mixture thereof is present in an amount from about 20 to about 80 weight percent, based on the total weight of the solution.

79. A process for inhibiting the corrosion of a machine resulting from the presence of absorbent solutions comprising at least one alkali metal hydroxide, alkaline earth metal hydroxide, or a mixture thereof, the process comprising circulating in a machine said absorption solution comprising at least one alkali metal hydroxide, alkaline earth metal hydroxide, or a mixture thereof, and at least one heteropoly complex anion of a transition metal element in an amount sufficient to provide a corrosion inhibiting effect.

80. The process of Claim 79, wherein said solution further comprises at least one additional additive comprising a compound selected from the group consisting of transition metal compounds, compounds of the metallic elements of Groups IIIa to VIa of the Periodic Table of Elements, and mixtures thereof in an amount sufficient to provide a corrosion inhibiting effect.

81. The process of Claim 79, wherein during said circulating step, said at least one heteropoly complex anion forms a protective layer on a surface within said machine.

82. The process of Claim 79, wherein during said circulating step said solution is exposed to temperatures ranging from about 150°F to about 550°F.

5 83. The process of Claim 79, wherein said absorbent solution further comprises lithium nitrate and zinc halide.

84. The solution of Claim 79, wherein said alkali metal hydroxide, alkaline earth metal hydroxide or mixture thereof is present in an amount from about 20 to about 80 weight percent, based on the total weight of the solution.

10 85. An absorption solution for refrigeration systems, comprising aqueous ammonia and at least one halide of a Group Va metallic element in an amount sufficient to provide a corrosion inhibiting effect.

86. The solution of Claim 85, wherein said at least one halide of a Group Va metallic element comprises antimony bromide (SbBr_3).

15 87. The solution of Claim 85, wherein said at least one Group Va metallic element is present as halide in an amount of about 10 ppm to about 3000 ppm.

20 88. A process for inhibiting the corrosion of a machine resulting from the presence of aqueous ammonium absorbent solutions, comprising circulating in a machine an absorption solution comprising ammonium and at least one halide of a Group Va metallic element in an amount sufficient to provide a corrosion inhibiting effect.

89. An absorption solution for refrigeration systems, comprising at least one alkali metal hydroxide, alkaline earth metal hydroxide, or a mixture thereof and at least one halide of a Group Va metallic element in an amount sufficient to provide a corrosion inhibiting effect.

25 90. The solution of Claim 89, wherein said at least one halide of a Group Va metallic element comprises antimony bromide (SbBr_3).

91. The solution of Claim 89, wherein said at least one Group Va metallic element is present as halide in an amount of about 10 ppm to about 3000 ppm.

92. A process for inhibiting the corrosion of a machine resulting from the presence of alkali metal hydroxide, alkaline earth metal hydroxide, or a mixture thereof
5 absorbent solutions, comprising circulating in a machine an absorption solution
comprising at least one alkali metal hydroxide, alkaline earth metal hydroxide, or a
mixture thereof and at least one halide of a Group Va metallic element in an amount
sufficient to provide a corrosion inhibiting effect.

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